Chapter 4 : Operation On Set

INTERSECTION OF SET

An intersection of sets exists when there are more than one set. The intersection of sets P and Q is written using the symbol $\cap$. Set $P \cap Q$ contains the common elements of both sets P and Q.

It is given that the universal set, $\xi = \{x : x \text{ is an integer}, 1 \leqslant x \leqslant 10\}$, set $P = \{x : x \text{ is an odd number}\}$, set $Q = \{x : x \text{ is a prime number}\}$ and set $R = \{x : x \text{ is a multiple of } 3\}$.

(a) List all the elements of the following intersections of sets.

(i) $P \cap Q$ (ii) $P \cap R$ (iii) $Q \cap R$ (iv) $P \cap Q \cap R$

(b) State the number of elements of the following sets.

(i) $n(P \cap Q)$ (ii) $n(P \cap R)$ (iii) $n(Q \cap R)$ (iv) $n(P \cap Q \cap R)$

Solution:

(a) (i) $P \cap Q$

$P = \{1, 3, 5, 7, 9\}$

$Q = \{2, 3, 5, 7\}$

$P \cap Q = \{3, 5, 7\}$

(ii) $P \cap R$

$P = \{1, 3, 5, 7, 9\}$

$R = \{3, 6, 9\}$

$P \cap R = \{3, 9\}$

(iii) $Q \cap R$

$Q = \{2, 3, 5, 7\}$

$R = \{3, 6, 9\}$

$Q \cap R = \{3\}$

(iv) $P \cap Q \cap R$

$P = \{1, 3, 5, 7, 9\}$

$Q = \{2, 3, 5, 7\}$

$R = \{3, 6, 9\}$

$P \cap Q \cap R = \{3\}$

MY MEMORY

$B \subset A$

Set B is a subset of set A when all the elements of set B are found in set A.

INFO ZONE

The symbol $\subseteq$ can also be used to denote subset.

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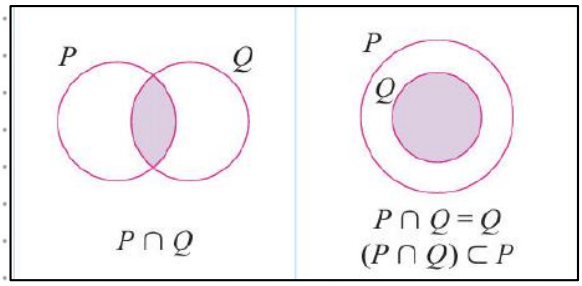
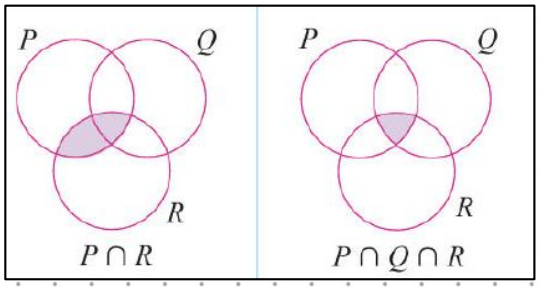
THE INTERSECTION OF TWO OR MORE SETS USING VENN DIAGRAMS

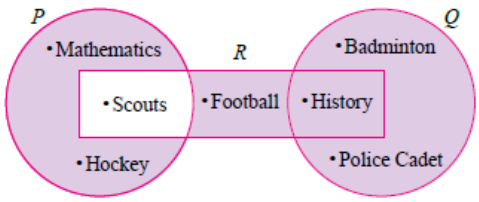




COMPLEMENT OF AN INTERSECTION OF SET

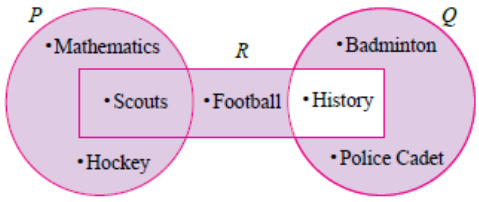
(a) (i) $P \cap R$ = {Scouts}
$(P \cap R)'$ = {Mathematics, Hockey, Football, History, Badminton, Police Cadet}

(b) (i)



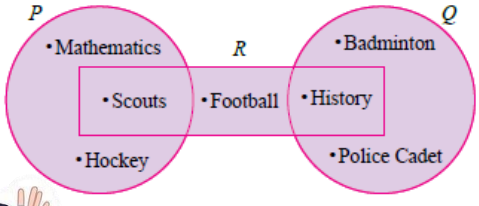
(a) (ii) $R \cap Q$ = {History}
$(R \cap Q)'$ = {Scouts, Mathematics, Hockey, Football, Badminton, Police Cadet}

(b) (ii)



(a) (iii) $P \cap Q \cap R$ = { }
$(P \cap Q \cap R)'$ = {Scouts, Mathematics, Hockey, Football, History, Badminton, Police Cadet}

(b) (iii)



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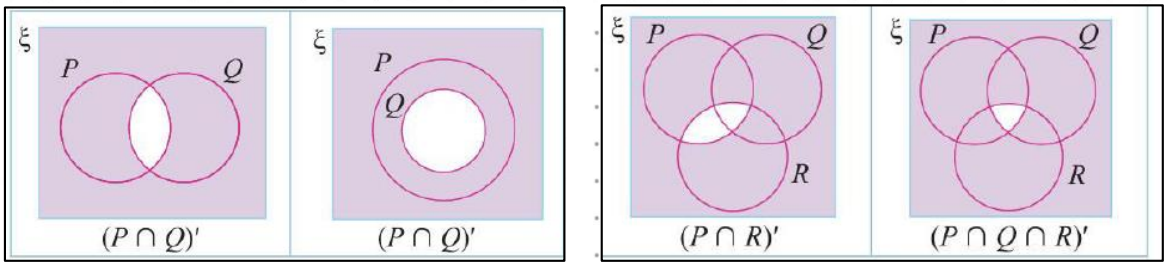
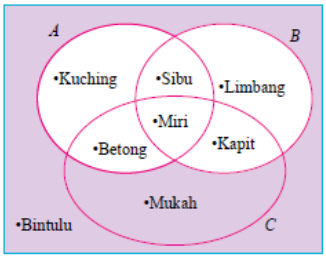
COMPLEMENT OF THE INTERSECTIONS OF TWO OR MORE SETS ON VENN DIAGRAM



COMPLEMENTS OF UNIONS OF TWO OR MORE SETS USING VENN DIAGRAM

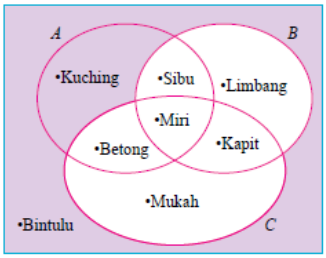
(a) (i) $A \cup B$ = {Kapit, Miri, Sibu, Limbang, Kuching, Betong}
$(A \cup B)'$ = {Mukah, Bintulu}

(b) (i)



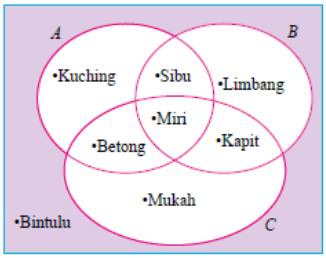
(a) (ii) $B \cup C$ = {Kapit, Miri, Sibu, Limbang, Betong, Mukah}
$(B \cup C)'$ = {Kuching, Bintulu}

(b) (ii)



(a) (iii) $A \cup B \cup C$ = {Kapit, Miri, Sibu, Limbang, Mukah, Betong, Kuching}
$(A \cup B \cup C)'$ = {Bintulu}

(b) (iii)



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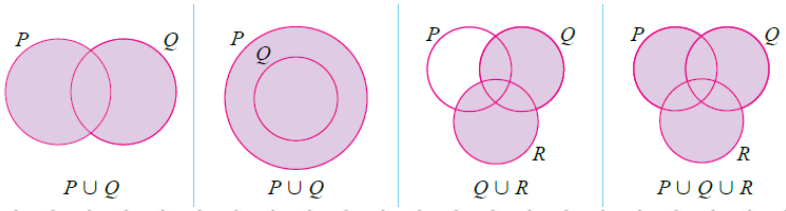
UNION OF SET

The union of sets P and Q is written using the symbol $\cup$. $P \cup Q$ represents all the elements in set P or set Q or in both sets P and Q.



It is given that set P = {factors of 24}, set Q = {multiples of 3 which are less than 20} and set R = {multiples of 4 which are less than 20}.

(a) List all the elements of the following unions of sets.

(i) $P \cup Q$ (ii) $P \cup R$ (iii) $Q \cup R$ (iv) $P \cup Q \cup R$

(b) Draw a Venn diagram to represent sets P, Q and R, and shade the regions that represent the following unions of sets.

(i) $P \cup Q$ (ii) $P \cup Q \cup R$

Solution:

(a) (i) P = {1, 2, 3, 4, 6, 8, 12, 24}
Q = {3, 6, 9, 12, 15, 18}
$P \cup Q$ = {1, 2, 3, 4, 6, 8, 9, 12, 15, 18, 24}

(ii) P = {1, 2, 3, 4, 6, 8, 12, 24}
R = {4, 8, 12, 16}
$P \cup R$ = {1, 2, 3, 4, 6, 8, 12, 16, 24}

(iii) Q = {3, 6, 9, 12, 15, 18}
R = {4, 8, 12, 16}
$Q \cup R$ = {3, 4, 6, 8, 9, 12, 15, 16, 18}

(iv) P = {1, 2, 3, 4, 6, 8, 12, 24}
Q = {3, 6, 9, 12, 15, 18}
R = {4, 8, 12, 16}
$P \cup Q \cup R$ = {1, 2, 3, 4, 6, 8, 9, 12, 15, 16, 18, 24}

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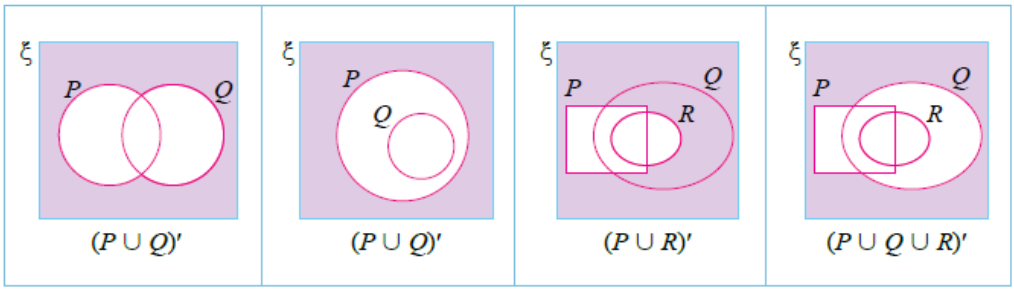
COMPLEMENT OF THE UNION OF SETS

The complement of the union of sets is written as $(A \cup B)'$, and is read as "the complement of the union of sets A and B".
The complement of the union of sets A and B refers to all the elements not in set A and set B.



Given the universal set, $\xi = \{x : x \text{ is an integer, } 50 \leqslant x \leqslant 60\}$, set $G = \{x : x \text{ is a prime number}\}$, set $H = \{x : x \text{ is a multiple of 4}\}$ and set $I = \{x : x \text{ is a multiple of 5}\}$, list all the elements and state the number of elements of the following sets.

(a) $(G \cup H)'$ (b) $(G \cup I)'$ (c) $(H \cup I)'$ (d) $(G \cup H \cup I)'$

Solution:

$\xi = \{50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60\}$
$G = \{53, 59\}$
$H = \{52, 56, 60\}$
$I = \{50, 55, 60\}$

(a) $G \cup H = \{52, 53, 56, 59, 60\}$
$(G \cup H)' = \{50, 51, 54, 55, 57, 58\}$
$n(G \cup H)' = 6$

(b) $G \cup I = \{50, 53, 55, 59, 60\}$
$(G \cup I)' = \{51, 52, 54, 56, 57, 58\}$
$n(G \cup I)' = 6$

(c) $H \cup I = \{50, 52, 55, 56, 60\}$
$(H \cup I)' = \{51, 53, 54, 57, 58, 59\}$
$n(H \cup I)' = 6$

(d) $G \cup H \cup I = \{50, 52, 53, 55, 56, 59, 60\}$
$(G \cup H \cup I)' = \{51, 54, 57, 58\}$
$n(G \cup H \cup I)' = 4$

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